

Employment

Job Analysis as Related to Visual Skills

N. FRANK STUMP, Ph.D.
Rochester, N. Y.

National Society for the
Prevention of Blindness, Inc.
1790 Broadway, New York 19, N. Y.

Reprinted from *The Sight-Saving Review*
Vol. XVIII, No. 4

Job Analysis as Related to Visual Skills*

N. Frank Stump, Ph.D.

Bausch and Lomb Optical Company, Rochester, N. Y.

EMPLOYER as well as employee benefits from an industrial vision service based on a fact-finding system.

THE interpretation of job analysis depends upon the purposes to be achieved and the methods applied to attain the specific objectives which have been set. One type of job analysis is used by the personnel and employment manager. Another type is used by the director of training. Still another type is used by the industrial engineer.

The different methods of job analysis are defined specifically by the different applications and results to be attained. Personnel and employment managers determine the main psychological characteristics that an employee *must* have to fill a particular job satisfactorily. So, they use the psychological method of testing and interviewing. The director of training aims to determine the specific steps to be taken in teaching a job to a new employee by investigation of particular work methods, thereby guiding the adoption by the employee of the best procedures during the learning period. The industrial engineer aims to simplify a job by the elimination of unnecessary motions or by a changed work layout using motion and time studies.

Within recent years it has been suggested that job analysis be conducted by a "visual engineer" whose objective would be to determine individual visual skills involved in the performance of specific jobs.

* Presented at the 1948 Graduate Course on Occupational Aspects of Ophthalmology of the New York University College of Medicine, New York, N. Y., with the cooperation of the National Society for the Prevention of Blindness.

Check Listing Visual Skills

There are several methods which may be used to gather the desired information concerning the visual skills required. One procedure consists of actual observation of the job and then subjectively checking the various visual skills needed. Before the check list is made, it is assumed that information of a pertinent nature is secured from the personnel department. The individual conducting such a survey must have the prescribed qualifications of each individual job, which consists of the physical and educational requirements of the employee as related to the machine and the materials used. The physical and educational requirements usually consist of a somewhat complete description of such factors as training and skills, hand dexterity, concentration of attention, and other factors.

The complexity of each job must also be known. Does the job consist of a single process such as inspection, or does it consist of a number of processes requiring the use of raw materials which move through a series of steps toward the finished product?

Even after all this information is secured, before a check list is attempted, the use of this subjective method involves many difficulties in order to determine the visual skills needed for a job. Observation alone cannot reveal all the facts. Obviously, it is simple enough to determine by observation alone that the employee works on a near-point or a far-point job. It may be possible, occasionally, to determine whether color discrimination is necessary. When, however, we look at the job and then at the man, it is almost impossible to say what degree of near-point muscle balance is desirable or whether a certain amount of far-point muscle balance is desirable as related to the near-point. Facts may not confirm opinions; color discrimination or near-point muscle balance of a specific order may not be necessary at all for the successful performance of a job, and yet opinion might dictate that they are.

While a check list no doubt will add much knowledge of a general nature to the person doing the survey, it is questionable whether it conveys much information concerning the specific visual skills needed by the employee. Certainly, observation of this nature will determine whether the job is a foreign-body hazard; a fume or

splash hazard; whether the work is in motion or stationary; but the specific visual skills needed are far more difficult to detect.

Visual Skill Judged by Success on Job

To determine objectively the visual skills needed, a second procedure can be used. It must be kept in mind that job analysis is concerned with the qualifications needed for success on a particular job. Since success was a basic phase of our definition of job analysis, it is logical to include it when determining the specific visual skills needed for success. In order to do this, a criterion of success on the job is of paramount importance. What is the criterion desired? Is it the amount of production, or the quality of production, or minimum amount of throw-outs at inspection, or ability to avoid accidents, or a combination of these? Once the criterion or combination of criteria of success is determined, then only can the visual skills of the successful employee be discovered objectively and scientifically. It can also be shown that the unsuccessful employee lacks certain visual skills possessed by the successful individual.

When it is discovered *what* visual skills are needed for success, the next objective approach is to determine *what degree* or *how much* of these visual skills are needed. True job analysis, it is pointed out, does not consist of an "all-or-none" process. It is more than saying this human characteristic is needed or it is not needed. Visual job analysis must first determine what visual skills are essential for success and then discover what degree or how much of those skills is needed.

Problems in Visual Job Analysis

The primary purpose of this paper is to discuss job analysis with the psychological method, delimiting the materials specifically to visual performance testing and its implications for the eye doctors.

Cooperation among the industrial executive, the ophthalmic professions, and the ophthalmic manufacturer is imperative if desired results are to be accomplished. Only through teamwork can the industrial and commercial employee receive the desired advantages from visual job analysis. In many industrial organizations complete cooperation among these three groups has already been

well established. The services rendered by each of these groups have not reached perfection, but it can be reached eventually.

In order to show the interrelationship of the industrial employee, the ophthalmic professions, and the ophthalmic manufacturer, the following problems will be considered:

1. How important is visual performance as compared to other personnel tests in determining satisfactory job performance?
2. How does the eye doctor enter the picture?
3. What does the employer expect to derive from a carefully controlled system of fact finding relative to visual job analysis?
4. How is the industrial employee benefited by facts concerning his visual performance?
5. How do minimum visual standards which are set on a fact-finding basis contribute to better vision of the employee?

Visual Performance and Other Psychological Factors

Since one phase of job analysis attempts to reveal the important physical and psychological characteristics needed in successful performance of various jobs, the importance of one human characteristic as compared with another is a proper subject of investigation. Only a beginning has been made to determine objectively the relative importance of various psychological characteristics, vision being one of them. So, the major part of this problem is yet to be solved. Future research, alone, will give the answer to the comparative importance of visual performance in relationship to other psychological factors needed in the successful employee.

Recently a study* was made which shows the relationship of success on the job and visual performance. This study also reveals the part played by the addition of one orthodox current psychological test to the visual performance tests. It furthermore shows the part which two psychological measures play in combination with visual performance. By this means it can be pointed out that, so far as these three psychological tests go, i.e., visual, general mental ability, and ability to read blueprints and make simple measurements, the visual performance tests were the most significant characteristics investigated so far as this job is concerned, namely inspection. The study indicated that the percentage of successful workers

* Reported in *Mill and Factory*, April, 1947, p. 98-102.

increased as the number of visual performance tests included in the visual pattern for inspectors is passed. For instance, there were 8 visual tests included in the pattern for inspectors, so, 6, 7, or 8 tests in this pattern were passed by 82 per cent of the good workers; 4 or 5 tests were passed by 36 per cent; 2 or 3 tests, by 28 per cent; and complete failure on the pattern, or ability to get only 1 out of the 8 tests correct, had only 25 per cent good men in the group. This constant relationship between success on the job and ability to pass a larger and larger number of visual performance tests is indicative of the importance of visual performance as a contributive factor in job success. For the purpose of job analysis such objective data should be obtained for each human factor before being accepted as important for job success.

The study showed further that if everyone is hired and placed on the job indiscriminately, then by the law of averages 50 per cent will be good workers and 50 per cent fair workers, using quality as a criterion of success. When vision was used alone as a possible psychological characteristic needed for success on the job, it was found that the number of good workers was substantially increased and that 64 per cent more good than fair workers were put on the job. The addition of a general mental ability test to the visual performance increased the selection over the vision test alone by 12 per cent, making the selection 76 per cent good workers. But the addition of two psychological tests to the vision tests, i.e., general mental ability and ability to read blueprints and make simple measurements, brought the selection up to 100 per cent of good workers, this being an increase of 24 per cent over the use of only two psychological tests.

Taking these same industrial employees—inspectors—and applying the criterion of quantity of production, the discriminating effect of visual performance verifies the facts found for quality of work.

From the standpoint of quantity production, it can be shown that other factors besides the three here considered must be discovered in order to produce the selection of 100 per cent of good workers. Nevertheless, visual performance again shows considerable selective advantage over the factors measured by a general ability test and a simple measurements test. In fact, either the

general mental ability test *or* the simple measurements test can be used for selection so far as production is concerned because each one contributed as much as the other to the selection of good workers after vision has been included as an important factor.

These facts are presented merely to show that there is a verification of the importance of certain psychological factors when different criteria of success on the job are used.

Psychologists have determined the importance of visual skills for job success on many jobs. Minimum patterns of visual skills have been constructed on nearly 2,000 industrial and commercial jobs on a fact-finding basis.

While it is true that there are considerable differences in the patterns of visual skills between various jobs, it is unusually revealing that visual performance is important to some degree in all jobs studied to date.

How Does the Ophthalmic Profession Enter the Picture?

Job analysis with the psychological method, with special reference to vision, is meaningless without professional services. Without them the remainder of the visual performance program would be useless and ineffective. So, many industrial organizations are collecting important facts concerning the minimum visual performance needs for success on many jobs, as the ophthalmic profession continues to use the results of the fact-finding approach to serve better these industrial organizations.

Referral Form Has Valuable Purpose.—The psychological approach can be a very real help by scientific determination of patterns of visual skills desirable for a job. These facts along with (1) the specific visual performance of the individual employee, (2) work distances, (3) illumination, and (4) degree of visual attentiveness, etc., required for the job, can be conveyed on the so-called referral form. For the ophthalmologist who wishes to conduct his practice entirely from his office, the psychological findings and the referral form can serve a very valuable purpose. The knowledge of the minimum visual requirements of a job, along with the specific visual skills in which the employee needs special visual help, can result in more comfortable, effortless, and efficient visual performance of the employee at his work, after professional correction.

Just as the social and economic order is gradually but certainly changing from the point of view of worrying constantly about one's "rights" to more emphasis upon one's "responsibilities," knowledge of the real meaning of a controlled visual performance program has led ophthalmologists with whom I have spoken to think more of the opportunities and responsibilities they have to commercial and industrial organizations. Everyone has appreciated this new point of view.

It is clear that close relationship between the ophthalmic professions, the ophthalmic manufacturer, and industrial and commercial organizations can be established in order to obtain the greatest benefits from any job analysis of visual patterns.

Ophthalmic Manufacturers Play Important Part.—Industrial organizations need the ophthalmic professions because they alone can diagnose and prescribe. But the ophthalmic professions cannot supply the complete means of giving industry all that is needed. It is necessary for the ophthalmic manufacturer and industrial organizations to help the ophthalmic men to identify the employees now on the job and new employees to be hired who likely would profit from professional services. The plan can be so organized that industry sees to it that men in this category go to the professional offices.

Every professional ophthalmic person has the opportunity to broaden his own knowledge of industrial jobs by visiting industrial plants and actually seeing the jobs performed. Industrial and commercial organizations appreciate it greatly when ophthalmologists are willing to enter the plants and observe the men at work.

Information about his job which the average employee can offer is inadequate and often inaccurate. He may give information concerning his work distance or the degree of visual concentration needed, but these facts may be misleading. Even when the personnel department uses the referral form to convey informational data to the ophthalmic profession, much could be gained by first-hand knowledge of the industrial job which is being performed.

The use of visual performance instruments, based on a fact-finding system has not only made it possible to determine the visual characteristics needed for success on the job, but has stimulated industrial employees to get correction for those skills on which they have been shown to have subnormal vision.

Eye Care Stimulated by Study of Visual Performance.—In 56 plants where an industrial vision service with the Ortho-Rater has been used for eighteen months or more, 114,500 employees have received the visual performance tests—an average of 2,044 per installation. Of these employees, 49,693 or 43.4 per cent were recommended by industry for professional attention—an average of 887 per plant. Of this number recommended for professional services, 736 or 83 per cent received professional services. Approximately 11 per cent of those who met the minimum visual performance standards for their jobs sought professional attention through the stimulation of the Industrial Vision Service with the Ortho-Rater. Prescriptions were written for 85 per cent of these referred cases. While orthoptic training was used in some cases, records are incomplete with regard to this phase. Sixty-seven per cent sought professional attention for the *first* time.

These facts show the real place which the ophthalmologists have in bringing industrial employees up to a minimum visual standard required for success on the job.

A visual performance program which scientifically determines the visual skills needed for a job and then accurately discovers *how much* or *what degree* of those visual skills are needed, not only serves its purpose for job analysis, but definitely hits at the heart of sub-standard visual performance through professional correction.

The administration of visual performance tests to employees has not only made possible the establishment of visual skills needed for success, but has also developed better employee-management relationships. Many thousands of industrial workers have requested a re-check on their visual performance. In many instances these employees have been benefited since, at a particular age, it has been found that a year or two has brought considerable change in visual performance and the ability to meet minimum visual standards for the job.

Periodic Re-check of Visual Performance is Encouraged.—Many industrial organizations are making it a practice to re-check all their workers at least once every two years. In the moderate sized plant, a re-check is customarily made every year. The development of a new visual standard as the average visual performance is increased through correction makes the visual performance service

a continuous one for industrial organizations. It also has the effect of keeping those employees who do not meet the standard conscious of the values of professional services.

Statistical facts are now available that indicate the values of eye professional services through correction. A study* was made of the effects produced by correction for employees who were working on a near-point job and on one which required considerable concentration of visual attention. The study showed improvements made by 103 employees who used correction for far vision and 182 who used correction for near vision. Since this was a near-point job, some employees used their glasses only at near distance. It is also interesting to learn that correction increased the average visual performance in acuity, both eyes, and the left and right eye separately by a significant degree.

These are facts which the professional eye man has observed every day in his practice, but now statistical proof is available to indicate the valuable effect of correction on visual performance.

Facts are now available that tests of visual performance have proved to be the means of establishing a clue to health problems; and thus, the card of introduction on visual skills has led to the discovery of goiter, diabetes, diseased tonsils and numerous other diseases in industrial employees because through periodic re-checks on visual performance these individuals have been brought into the offices of many medical men.

Visual Job Analysis Benefits the Employer

Quantity and Quality Production.—Because of the highly competitive nature of most industrial activities, employers expect to benefit by the use of visual job analysis. They hope to obtain a *larger amount* and *better quality* production for the customer.

Much data are now available to show that when employees have their "eyes right for the job" a better quality product even with increased production is possible. The great majority of employees in the excellent earning group met the visual standard. In fact, some workers in this group received four times as much pay as some other employees in the poor earning group. When these same employees were studied with regard to quality production, the

* See *The Optical Journal*, July 15, 1947, p. 40-44.

workers with the better visual performance were found to be the ones who had the highest quality record. Workers who met visual standards earned \$6.58 more a week than those who did not meet these same standards. This increase in quantity production which is reflected in the increased earnings was also accompanied by about 8 to 15 per cent betterment in terms of fewer rejects.

Reduction of Accidents.—The employer is also interested in reducing accidents among the workers. Evidence is now available which shows that inefficient vision is an important factor in industrial accidents.

Among three groups of employees, (1) an accident-free group; (2) a high-frequency-of-minor-accident group; and (3) a serious-injury group, 68 per cent more accident-free persons than serious-injury employees pass the depth perception or stereopsis test.

When a score of 5 on the Ortho-Rater depth test is taken as a critical score, 88 per cent of the accident-free group pass the test; 43 per cent of the high-frequency-of-minor-injury group pass it; and only 20 per cent of the serious-injury group made a score of 5 or more.

Reduction of Waste.—The employer is concerned with the reduction of the amount of scrap produced. The difference between 3 per cent and 5 per cent of scrap may be sufficient to produce an actual loss in profits in manufacturing. Only 22 per cent of the visually qualified workers had more than 5 per cent scrap, while 57 per cent of the visually unqualified workers had more than 5 per cent scrap. The visually qualified had on the average 2.6 per cent less scrap. There are many indications in this and other studies that efficient visual performance also means (1) less turnover; (2) better selection at employment; and (3) less absenteeism.

Visual Job Analysis Benefits the Employee

Evidence indicates that accidents which cause injury are much less prevalent among those employees with efficient visual performance. When industrial organizations insist that employees have "right eyes for the job" the employee is benefited and much suffering through prevention of accidents is thus avoided. There is a definite advantage in having a score of 10 or greater in acuity, both eyes at far, in order to be free of accidents. In this study it was

found that all the accident-free employees passed the test. Only 60 per cent of the high-frequency-of-minor-accident group passed; while 40 per cent of the serious-injury group scored 10 or better. So, 60 per cent more in the accident-free group met the standards than in the serious-injury group.

Many employees have also indicated that eye correction has resulted in great comfort, as well as in effortless and efficient job performance.

Employees have noted the decreased fatigue, through reduced eyestrain, brought about through eye correction.

Above all, perhaps, the employee is made eye conscious. He gets the feeling that vision is a most cherished possession and that vision should not only be protected with safety glass at hazardous jobs but should be given proper attention periodically by going to a professional eye man's office.

When an employee realizes that his quantity and quality of production is conditioned by his visual performance, that is all the argument he needs, in many cases, because he knows the size of his pay check is increased by efficient visual performance.

Minimum Visual Standards Contribute to Scientific Visual Job Analysis

Minimum visual standards might be set on a statistical basis in such a manner that varying percentages of the industrial population pass them. If the minimum visual standards are too severe, we might say 80 to 90 per cent of the employees would not pass them. For this reason, minimum visual standards are generally set on the basis that 30 to 40 per cent of employees do not pass them.

Furthermore, the standards which are set should discriminate adequately between the good worker and the less satisfactory employee. Standards should be set in such a way that a much greater percentage of good workers pass the primary tests than do poor workers. If the critical scores on each of the visual performance tests are carefully determined it has been found on hundreds of jobs that the visual superiority of the good worker when compared with the poor worker is generally a reality.

It should be pointed out that vision alone does not pick out all the good workers because obviously other factors than vision enter

to make a good worker. When all the evidence is in, however, I believe it will be found that visual performance tests will play a lion's share in discriminating the good from the poor worker.

Let us take one example* showing average hourly earnings in relationship to minimum visual requirements. Sixty-four per cent of the high earning group met the standards, while only 36 per cent of the low earning group met these same standards. In verifying findings, it was found that 14 per cent of the workers who did not meet the standards were in the high earning group; and 86 per cent not meeting standards were in the low earning group.

Summary

1. Ophthalmologists have tremendous opportunities to extend their arms of service to industrial organizations by giving the fullest cooperation to scientifically controlled visual performance programs.

2. Instead of using arbitrary judgments to determine visual skills needed for success on various jobs, visual performance may be determined by psychological and fact-finding procedures.

3. The scientific approach to visual performance in industry is to determine first *what* visual skills are desirable for success and then find *how much* or *what degree* of these visual skills are needed.

4. Employer as well as employee has many benefits to gain from an industrial vision service based on a fact-finding system.

5. A carefully controlled industrial vision service not only discovers those employees who need professional eye care but, by getting these persons in for ophthalmic examination, such physical ills as goiter, diabetes, enlarged tonsils, etc., have been detected.

6. By cooperative effort among the industrial executives, the ophthalmic professions, and the ophthalmic manufacturers, each group is able to meet its responsibilities to society much more effectively than has been done in the past.

References

1. Kephart, N. C.: An Example of Increased Production Through An Industrial Vision Program. *The Optical Journal*, September 15, 1946.

* See *The Optical Journal*, September 15, 1946.

2. Kephart, N. C.: Visual Skills Versus Employee Efficiency. *The Iron Age*, July 10, 1947, pp. 60-63.
3. Kuhn, Hedwig: *Industrial Ophthalmology*. St. Louis: C. V. Mosby Co., p. 19.
4. Purdue University Occupational Research Center.
5. Stump, N. F.: Selecting Inspectors by Visual and Psychological Tests. *Mill and Factory*, Vol. 40, pp. 98-102, April, 1947.
6. Stump, N. F.: Values of Professionally Prescribed Eye-Wear Shown Through Improvement of Visual Performance Scores. *The Optical Journal*, Vol. 84, pp. 40-44, July 15, 1947.
7. Stump, N. F.: Vision Tests Predict Worker Capability. *Factory Management and Maintenance*, Vol. 104, pp. 121-125, February, 1946.
8. Stump, N. F.: How Ophthalmic Eye-Care Can Prevent Many Industrial Accidents. *Transactions American Academy of Ophthalmology and Otolaryngology*, July-August, 1946, pp. 218-225.

THE NATIONAL SOCIETY FOR THE
PREVENTION OF BLINDNESS

is an incorporated voluntary organization engaged in a program of eliminating unnecessary loss of sight through education, preventive service and eye research.

Publications, posters, films, lectures, charts and advisory service are available on request.

The Society is supported entirely by membership dues and contributions, which are deductible for purposes of income taxes.